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Claims

[c1] A system for counteracting a disturbance in a spacecraft having a known sign, magnitude and time comprising:
a biasing apparatus coupled to the spacecraft; and
a spacecraft controller within the spacecraft, prior to the disturbance, said controller controlling the biasing apparatus to place the spacecraft in a first dynamic state as a function of the known sign, magnitude and time and controlling the biasing apparatus to place the spacecraft in a second dynamic state as a function of the known sign, magnitude and time so that the spacecraft is oriented in a position other than a desired orientation so that after the disturbance the spacecraft is oriented in the desired orientation in response to the disturbance.

[c2] A system as recited in claim 1 wherein the biasing apparatus comprises a momentum wheel.

[c3] A system as recited in claim 1 wherein the first dynamic state comprises an angular rate.

[c4] A system as recited in claim 1 wherein the second dynamic state comprises an angular position.

[c5] A system as recited in claim 1 wherein the first dynamic state comprises an angular rate and the second dynamic states comprises an angular position.

[c6] A system as recited in claim 1 wherein the disturbance comprises thruster momentum dumping.

[c7] A system as recited in claim 1 wherein said controller controls the biasing apparatus to move the spacecraft to the desired orientation after the disturbance.

[c8] A system as recited in claim 7 wherein the disturbance is centered between the controller controlling the biasing apparatus to a first dynamic state and controlling the biasing apparatus to a second dynamic state, and the controller controlling the biasing apparatus to move the spacecraft to the desired orientation after the disturbance.

[c9] A system as recited in claim 1 wherein the disturbance comprises deployment transients, release transients, latch up transients, liquid apogee motor turn on transients, solar array thermal snap transients or rendezvous docking transients.

[c10] A method of counteracting a disturbance in a spacecraft having a known sign, magnitude and time comprising: prior to the disturbance, initiating a first dynamic state

of the spacecraft as a function of the known sign, magnitude and time;

prior to the disturbance, initiating a second dynamic state of the spacecraft as a function of the known sign, magnitude and time; and

orienting the spacecraft in a desired position in response to the disturbance.

[c11] A method as recited in claim 10 wherein the first dynamic state comprises an angular rate.

[c12] A method as recited in claim 10 wherein the first dynamic state comprises an angular position.

[c13] A method as recited in claim 10 wherein the disturbance comprises thruster firing.

[c14] A method as recited in claim 10 wherein the disturbance comprises thruster momentum dumping.

[c15] A method as recited in claim 10 wherein the step of orienting comprises applying the disturbance counter to the first dynamic state and the second dynamic state.

[c16] A method as recited in claim 10 wherein orienting the spacecraft in a desired position in response to the disturbance comprises orienting the spacecraft in a desired position in response to the disturbance and controlling a

biasing apparatus.

[c17] A method as recited in claim 10 wherein initiating the first dynamic state and initiating the second dynamic state comprises controlling a momentum wheel.

[c18] A method of dumping momentum in a spacecraft having a known sign, magnitude and time comprising:
commanding the spacecraft to move from a first position to an angular offset equal to an allowable transient angular excursion opposite in direction to a transient from the disturbance when torque is unloaded from a momentum wheel;
commanding a predetermined torque to unload the momentum wheel;
slewing the spacecraft to begin to reduce the angular offset in response to the predetermined torque;
commanding a thruster to apply an impulse to the wheel twice the size of that required to halt the slewing;
continuing to apply the predetermined torque from the momentum wheel until the slew is halted; and
slewing the spacecraft to the first position.

[c19] A method as recited in claim 18 wherein the predetermined torque comprises a full torque value.

[c20] A method as recited in claim 18 wherein commanding

the spacecraft to move from a first position to an angular offset, commanding a predetermined torque to unload the wheel, slewing the spacecraft to begin to reduce the angular offset, continuing to apply the predetermined torque until the slew is halted, slewing the spacecraft to the first position have a time period associated therewith, said step of commanding a thruster to apply an impulse is centered within the time period.

[c21] A method as recited in claim 18 wherein during the step of commanding, suspending open loop control.

[c22] A method as recited in claim 18 wherein the step of continuing is performed for a predetermined time.

[c23] A method as recited in claim 18 wherein the step of continuing is performed until a predetermined position is reached.

[c24] A method as recited in claim 23 wherein the predetermined position is determined by a gyroscope.

[c25] A method as recited in claim 23 wherein the predetermined position is the allowable transient angular excursion.

[c26] A spacecraft comprising:
a momentum wheel;

a thruster; and

a controller coupled to the momentum wheel and the thruster, said controller controlling the momentum wheel to move the spacecraft from a first position to an angular offset equal to an allowable transient angular excursion opposite in direction to a transient from the disturbance when torque is unloaded from a momentum wheel, said controller commanding the application of a predetermined torque to unload the momentum wheel, said controller slewing the spacecraft to begin to reduce the angular offset in response to the predetermined torque, said controller commanding the thruster to apply an impulse to the spacecraft twice the size of that required to halt the slewing, said controller continuing to apply the predetermined torque to the momentum wheel until the slew is halted and controlling the momentum wheel to slewing the spacecraft to the first position.

[c27] A spacecraft as recited in claim 26 wherein the momentum wheel comprises a gimbaled momentum wheel, control momentum gyro or one or more of multiple reaction wheels.

[c28] A spacecraft as recited in claim 26 wherein the predetermined torque comprises a full torque value.

[c29] A spacecraft as recited in claim 26 wherein the controller

commands slewing the spacecraft to the first position that has a time period associated therewith, said controller commanding a thruster to apply an impulse centered within the time period.

[c30] A spacecraft as recited in claim 26 wherein when the spacecraft controller commands a predetermined torque, said controller suspends open loop control.

[c31] A spacecraft as recited in claim 26 wherein the controller continues to command applying the impulse for a predetermined time.

[c32] A spacecraft as recited in claim 26 wherein the controller continues to command applying the impulse until a predetermined rate is reached.

[c33] A spacecraft as recited in claim 26 wherein the predetermined position is determined by a gyroscope.